

History of Blood Transfusion, Tattooing, Acupuncture and Risk of Hepatitis B Surface Antigenaemia among Chinese Men in Singapore

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Abstract: To determine whether a history of blood transfusion, tattooing, and acupuncture is associated with an increased risk of hepatitis B surface antigenaemia, a study of 6,328 Chinese men between 35 and 65 years of age was undertaken in Singapore. The age-adjusted odds ratios were 1.44 (95% CI: 1.14, 1.83) for blood transfusion, 1.14 (95% CI: 0.80, 1.63) for tattooing, and 0.88 (95% CI: 0.71, 1.11) for acupuncture. Using no history of any of the three

percutaneous procedures as reference, the age-adjusted odds ratio for blood transfusion only was 1.40, 95% CI: 1.07, 1.84, and for blood transfusion plus tattooing was 2.59, 95% CI: 1.18, 5.70. The proportion of HBsAg positive cases attributable to blood transfusion and tattooing, as measured by the population attributable risk, are 4.1 and 0.7 per cent, respectively. (*Am J Public Health* 1988; 78:958-960.)

Introduction

Hepatitis B virus (HBV) infection is endemic in many parts of the world. Chronic HBV carriers provide a human reservoir and transmission is known to occur by percutaneous exposures such as blood transfusion, tattooing, surgical procedures, acupuncture, plasma derivative therapy, or by non-percutaneous means, such as mother-to-child, intrafamilial and sexual contacts.¹ HBV infections occur frequently in high-prevalence areas; one study has reported that 50 per cent of the population in Singapore have some markers of HBV infection by 50 years old.²

The Department of Community, Occupational and Family Medicine, National University of Singapore, has an ongoing cohort study on the association between HBV and the development of hepatocellular carcinoma. This paper reports on the findings of 6,328 adult men of Chinese origin derived from this cohort who completed a questionnaire on past history of blood transfusion, tattooing, and acupuncture. The primary interest of this study is to examine these three percutaneous procedures as risk factors in the development of hepatitis B antigenaemia, and the proportion of HBsAg positive cases attributable to them in our sample.

Methods

The study population consisted of 6,328 Chinese men aged between 35 and 65 years. They were drawn from the following sources:

- **Healthy blood donors:** 303 subjects who were first-time blood donors (repeat blood donors were excluded) at the Singapore Blood Transfusion Service;
- **Other apparently healthy subjects:** 358 subjects from the following sources: An on-going population-based prospective study of cardiovascular disease risk factors; multiphasic screening of asymptomatic subjects at a government hospital; screening of HBsAg among hospital staff; workers in a large statutory board; members of an old peoples' club; and members of church groups;

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- **Outpatient non-hepatic subjects:** 343 subjects from patients attending the private clinics of five general practitioners and two private laboratory services. Patients with jaundice or symptoms or signs suggestive of liver disease were excluded from our sample;
- **Hospital non-hepatic subjects:** 5,324 patients admitted to the general medical, general surgical, and orthopedic wards of two major government hospitals. Patients with jaundice or symptoms or signs suggestive of liver disease were excluded from our sample.

Serum specimens were tested for HBsAg by reversed passive haemagglutination test (AUSCELL test kit, Abbott Laboratories).

The risk of HBsAg positivity is expressed as a prevalence rate per 100 persons. The association of each exposure variable (history of blood transfusion, tattooing, and acupuncture) with the risk of HBsAg positivity is quantified by the odds-ratio^{3,4} and rate-difference⁵ adjusting for confounding bias via multiple logistic regression analysis. The population attributable risk was estimated according to the method described by Kahn.⁶

Results

Of the 6,328 subjects in the study, 626 (9.9 per cent) are HBsAg positive (Table 1). The prevalence rates did not show a discernible trend with age but did show a slight decline with increasing educational level.

Table 2 presents the HBsAg prevalence rates and odds ratios in relation to three percutaneous procedures considered individually. The age-adjusted odds ratio when com-

TABLE 1—Hepatitis B Surface Antigen Prevalence Rate per 100 Persons According to Age and Educational Level*

Characteristics	No. of Persons	Rate
Age (years)		
35-39	754	10.1
40-44	932	10.4
45-49	1039	10.9
50-54	1211	9.3
55-59	1165	10.0
60-65	1227	9.0
All Ages	6328	9.9
Educational Levels		
None	797	10.5
Primary	3199	10.4
Secondary	1762	9.1
Tertiary	529	8.3

*The HBsAg prevalence rate is neither significantly related to age ($p = 0.785$) nor to educational level ($p = 0.374$).

TABLE 2—Hepatitis B Surface Antigen Prevalence Rate per 100 Persons, Odds Ratio and Population Attributable Risk According to History of Blood Transfusion, Tattooing, and Acupuncture

History	No. of Persons	Crude Rate	Adjusted Rate*	Adjusted Odds Ratio* (95% CI)	Population Attributable Risk (%)
Blood Transfusion					
No	5585	9.4	9.4	1	
Yes	702	13.0	12.9	1.44 (1.14–1.83)	4.1
Tattooing					
No	5997	9.8	9.8	1	
Yes	325	11.1	11.0	1.14 (0.80–1.63)	0.7
Acupuncture					
No	5190	10.0	10.0	1	—
Yes	1081	9.0	8.9	0.88 (0.71–1.11)	

*Statistically adjusted for age based on the multiple logistic regression model. Additional adjustment for educational level did not alter the results materially.

pared to the corresponding non-exposed groups were 1.44 for blood transfusion, 1.14 for tattooing, and 0.88 for acupuncture. The proportions of HBsAg positive cases in our sample attributable to blood transfusion and tattooing, as measured by the population attributable risk, were 4.1 per cent and 0.7 per cent, respectively.

Table 3 presents the HBsAg prevalence rates and odds ratios of subjects in seven possible combinations with regard to their history of exposure to blood transfusion, tattooing, and acupuncture. Only five persons had a history of the combination of blood transfusion, tattooing, and acupuncture; they were excluded from the analysis). In general, the findings for the groups with history of blood transfusion only, tattooing only, and acupuncture only were similar to the results shown in Table 2 when the risk factors were considered individually. Relative to subjects with no history of any procedures, the adjusted odds ratio for the group with blood

TABLE 3—Hepatitis B Surface Antigen Prevalence Rate per 100 Persons and Odds Ratio According to Various Percutaneous Procedures

History	No. of Persons	Crude Rate	Adjusted Rate*	Adjusted Odds Ratio* (95% CI)
No history of any procedure	4362	9.5	9.5	1
Blood transfusion only	544	12.9	12.8	1.40 (1.07–1.84)
Tattooing only	219	11.0	10.9	1.16 (0.75–1.79)
Acupuncture only	904	8.7	8.7	0.91 (0.70–1.16)
Blood transfusion and tattooing	37	21.6	21.6	2.59 (1.18–5.70)
Blood transfusion and acupuncture	100	12.0	12.0	1.28 (0.70–2.37)
Tattooing and acupuncture	59	6.8	6.8	0.69 (0.25–1.91)

*Statistically adjusted for age based on the multiple logistic regression model. Additional adjustment for educational level did not alter the results materially. There were only five persons who had a history of blood transfusion, tattoo, and acupuncture; these subjects were excluded from analysis.

transfusion and tattooing is 2.59, blood transfusion and acupuncture 1.28, and tattooing and acupuncture 0.69.

Discussion

In this study, the proportion of persons who were exposed to these procedures may be underestimated due to recall bias. It is reasonable to assume, however, that a majority of the respondents are able to recall these distinct experiences, if any. It should be noted that there is probably an overrepresentation of persons with blood transfusion in our sample, compared to the general population, because a large proportion of our subjects were hospital inpatients.

The results suggest that a history of blood transfusion elevates the risk of HBsAg positivity by about 1.4 times relative to non-exposure. The risk increases to 2.6 times if the subject had a history of blood transfusion as well as tattooing. This finding is related to the screening practice for HBsAg of donors' sera by the national blood transfusion service in the past. Routine screening for HBsAg was first introduced in 1973 using the counter immunoelectrophoresis technique, and later by the more sensitive reversed passive haemagglutination technique since early 1980.⁷ The risk of developing HBsAg positivity from blood transfusion is expected to be reduced now and in the future with routine screening of donors for HBsAg. In a study done before the introduction of routine HBsAg screening in Singapore, Ong reported the risk of post-transfusion hepatitis of recipients following transfusion of an HBsAg positive unit: 65 per cent of 28 non-immune subjects, and 8 per cent of 38 subjects with anti-HBs developed protracted, persistent, or periodic antigenaemia.⁸

The practice of tattooing is fairly common among the adult Chinese men in Singapore. Our study results show some risk associated with this practice and are consistent with the known fact that tattooing in the past involved the frequent use of contaminated equipment. Tattoo-associated outbreaks of hepatitis infection have been reported in Singapore: three in 1977, five in 1978, 13 in 1979, and 11 in 1980.⁹ Periodic inspections of the tattoo shops were subsequently stepped up by the public health authorities. Possibly as a result, only three tattoo-associated hepatitis cases were reported in 1981.

A history of acupuncture was reported by 17 per cent of our respondents. Acupuncture is practiced mainly by the traditional Chinese practitioners, called "sinsehs", in Singapore. They usually sterilize the acupuncture needles by heating or by immersing them in antiseptic chemicals before usage. Our study does not demonstrate an increased risk for HBsAg positivity in subjects with history of acupuncture compared to the unexposed group. Nonetheless, it seems valid to continue educating the acupuncturists on the potential danger of HBV transmission.

One major assumption in the application of the population attributable risk is that a particular risk factor is entirely independent of the other risk factors. As a consequence, potential correlations or interactions with other risk factors have to be ignored. On this basis, Table 2 shows that 4.1 per cent and 0.7 per cent of the HBsAg positive cases could be attributed to blood transfusion and tattooing, respectively. Admittedly, this deduction may be an oversimplification. Nonetheless, the results suggest that the two risk factors, blood transfusion and tattooing, probably account for less than 5 per cent of the HBsAg positive cases in the cohort. Thus, other risk factors must have contributed to the pool of HBsAg positive cases in the cohort.

One important manner contributing to the reservoir of

carriers identified in other studies is perinatal transmission.¹⁰⁻¹² Once infected during the perinatal period, over 90 per cent of infants remain carriers. In a study of maternal-child HBV transmission in Singapore, Chan, *et al*, estimated that about 18 per cent of the total pool of HBsAg positive infants at one year of age may be contributed by perinatal transmission.¹³

Goh, *et al*, reported on the importance of HBV infections acquired horizontally from carriers within the same household in Singapore. He found factors associated with increased risk of HBV transmission included sharing of personal and household articles, such as toothbrush, towel, handkerchief, clothing, razor, comb, bed, and bedding.¹⁴ There is thus an urgent need to identify the risk factors in the transmission of HBV and their contributions to the pool of HBsAg carriers in the community. Only then could we be able to formulate comprehensive strategy to eliminate all the sources of HBV infection.

In summary, our study shows that although blood transfusion and tattooing contributed only a small proportion of the load of hepatitis B antigenemia in the entire sample, there appears to be a definite increase of risk of HBsAg positivity at the individual level for a person with such exposures.

ACKNOWLEDGMENTS

We thank our six field investigators for conducting the interviews; Messrs C. B. Chia and N. Y. Khoo for doing the laboratory work; Ms. Gloria Lim for helping to coordinate the project; and all others who have helped us in various ways. We also gratefully acknowledge the financial support given to us by the International Agency for Cancer Research and the National University of Singapore (Research Grant No. 04699L).

REFERENCES

1. Gerety RJ, Tabor E: The epidemiology of hepatitis B. In: Gerety RJ (ed): Hepatitis B. London: Academic Press, 1985; 77-93.
2. Chan SH, Oon CJ: Epidemiology of HBV infection in Singapore. *Asian Pacific J Allerg Immunol* 1984; 2:139-143.
3. Breslow NE, Day NE: Statistical methods in cancer research. I: Analysis of case-control studies. Lyon, France: International Agency for Research on Cancer, 1980.
4. Lee J: An insight on the use of multiple logistic regression analysis to estimate association between risk factor and disease occurrence. *Int J Epidemiol* 1986; 15:22-29.
5. Lee J, Lee HP: Correcting for baseline differences in the comparison of rates. *Comput Biol Med* 1987; 17:357-362.
6. Kahn HA: An Introduction to Epidemiologic Methods. New York: Oxford University Press, 1983.
7. Ong YW: The development of blood services in Singapore. *Ann Acad Med Singapore* 1982; 11:411-417.
8. Ong YW: Some clinical and epidemiological aspects of HBs antigenemia and alpha-fetoprotein levels in Singapore. In: Liver Cancer, cancer problems in Asian countries. Proceedings of the AFOCC, 2nd Asian Cancer Conference, in Singapore, 1976; 57-60.
9. Goh KT: Epidemiological surveillance of communicable diseases in Singapore. Tokyo: SEAMIC Pub. No. 35, 1983; 138-139.
10. Stevens CE, Beasley RP, Tsui J, Lee WC: Vertical transmission of hepatitis B antigen in Taiwan. *N Engl J Med* 1975; 292:771-774.
11. Beasley RP, Trepo C, Stevens CE, Szmuness W: The e antigen and vertical transmission of hepatitis B surface antigen. *Am J Epidemiol* 1975; 105:94-98.
12. Nishioka K: Predominant mode of transmission of hepatitis B virus: Perinatal transmission in Asia. In: Vyas GN, Dienstag JL, Hoofnagle JH (eds): Viral Hepatitis and Liver Disease, 1984; 423-432.
13. Chan SH, Tan KL, Goh KT, *et al*: Maternal-child hepatitis B virus transmission in Singapore. *Int J Epidemiol* 1985; 14:173-177.
14. Goh KT, Ding JL, Monteiro EH, Oon CJ: Hepatitis B infection in households of acute cases. *J Epidemiol Community Health* 1985; 39:123-128.

WGBH Boston Receives \$4 Million RWJ Foundation Grant for AIDS Series

Citing the need for a "regular and reliable public media forum on AIDS," the Robert Wood Johnson Foundation recently awarded a grant of nearly \$4 million to WGBH Boston to produce a prime-time series on the AIDS epidemic, to air nationally on the Public Broadcasting Service (PBS).

Slated to premier in late fall 1988, the series, entitled "The AIDS Quarterly," will be a joint presentation of NOVA and FRONTLINE, two existing WGBH series, and will cover the "public policy, scientific, legislative, service, research and community response issues related to AIDS," according to Leighton E. Cluff, MD, president of the Princeton-based Robert Wood Johnson Foundation. "We're taking a decidedly nontraditional approach to expanding public awareness and understanding of the AIDS epidemic—an area of demonstrated importance to this foundation," said Cluff. The RWJ Foundation has committed \$26.9 million to AIDS efforts thus far, making it the leading private funder in that area.

Each of the one-hour programs in the AIDS series will follow a news/documentary magazine format, providing the flexibility to respond to breaking news as well as more complex issues. In addition to the quarterly series, the \$4 million grant also will enable WGBH's AIDS Project to:

- acquire, produce and air two to three one-hour documentary specials on specific aspects of the AIDS epidemic;
- sponsor international co-productions; and
- launch a national educational outreach campaign, based on the series, that will target schools, voluntary organizations, businesses, community agencies and the general public.